A 10: Precision spectroscopy of atoms and ions II (with Q)

Time: Monday 16:30–18:00 Location: F 428

A 10.1 Mon 16:30 F 428

Microwave field imaging using microfabricated vapor cells — •Guan-Xiang Du[1], Andrew Horsley[1], Matthieu Lucien Pellaton[1], Christoph Affolderbach[2], Gaetano Mileti[2], and Philipp Treutlein[1] — [1]Department of Physics, University of Basel, CH-4056 Basel, Switzerland — [2]Laboratoire Temps-Fréquence - University of Neuchâtel, 2000 Neuchâtel, Switzerland

We have recently demonstrated a technique for 2D microwave (mw) field imaging using alkali atoms in a milimeter-thick vapor cell.[1] Micrometer-scale miniaturized microwave circuits in industry, however require microfabricated vapor cell to look at details into the vicinity of the circuit waveguides. The 3D spatial resolution is achieved via micrometer-scale sensing volume with one dimension confined by the thickness of the vapor cell and the other two by introducing a buffer gas. The factors that suppress the coherence time include, collisions of alkali atoms with cell wall, alkali-buffer gas collisions, and alkali-alkali spin exchange collisions, are investigated. We report the status of our experiments on mw field imaging with such microcells.

[1]Pascal Bohi and Philipp Treutlein, Appl. Phys. Lett. 101, 181107 (2012).

A 10.2 Mon 16:45 F 428

Hochspannungsmessung mittels kollinearer Laserspektroskopie — •Elisa Will[1], Nadja Frömmgen[1], Christopher Geppert[1,2,3], Christian Gorges[1], Michael Hammen[1,3], Simon Kaufmann[1], Andreas Krieger[1,2,3], Wilfried Nörtershäuser[1,2,3] und die TRIGA-SPEC-Kollaboration[1] — [1]Institut für Kernchemie Mainz — [2]Helmholtz-Institut Mainz — [3]TU Darmstadt

Bereits im Jahr 1982 wurde experimentell demonstriert, dass es möglich ist, aus der Dopplerverschiebung der Resonanzlinien schneller Atome oder Ionen in der kollinearen Laserspektroskopie, die Hochspannung zu bestimmen, mit der die Ionen zuvor beschleunigt wurden [1]. Dies stellt eine Alternative zur elektronischen Messung mittels Spannungsteilern dar. Der letzte Versuch, die Genauigkeit der Methode zu steigern, erfolgte im Jahr 2004. Dabei konnten Hochspannungen im Bereich von -20 kV bis -50 kV mit einer relativen Genauigkeit von etwa 10^{-4} gemessen werden [2]. Die präzise Messung von Hochspannungen ist von generellem Interesse für die Metrologie, aber auch für verschiedene Experimente der aktuellen Grundlagenforschung, beispielsweise für das KATRIN-Experiment, welches eine relative Genauigkeit in der Hochspannungsmessung von 10^{-6} erfordert [3]. Aktuell werden Tests zur Erhöhung der Genauigkeit der kollinearen Methode am TRIGA-LASER-Experiment in Mainz durchgeführt. Erste Ergebnisse werden vorgestellt.

[1] O. Poulsen, Nucl. Instr. and Meth. 202 (1982), 503-509
[2] S. Götte et al., Rev. Sci. Instrum. 75 (2004) 1039-1050
[3] T. Thümmler, New J. Phys. 11 (2009) 103007

A 10.3 Mon 17:00 F 428

Sensitive detection of fast, neutral hydrogen atoms for the Bound Beta-Decay (BoB) Experiment — •Josephine McAndrew — Technische Universität München

We are currently exploring methods to detect hydrogen atoms with 325.7 eV kinetic energy. These atoms form the decay signature of the theoretically-predicted three-body decay of the neutron into a hydrogen atom and an anti-neutrino. The challenge in designing and building such a hydrogen detector lies in the small predicted branching ratio for this decay (~10^-6 of the three-body decay), the low energy of the atoms and the requirement to identify them over background hydrogen. This talk will describe our preliminary work investigating three possible detection schemes: quenching of H(2s) atoms and subsequent detection of the resulting Lyman-α photon, charge-exchange of hydrogen atoms in argon gas and laser ionisation.

A 10.4 Mon 17:15 F 428

Towards Radiation Detected Resonance Ionization Spectroscopy on transfermium elements in a buffer gas cell — •Felix Lautenschläger[1], Mustapha Laatiaoui[2,3], Michael Block[2,3], Werner Lauth[4], Hartmut Backe[4], Thomas Walther[1], and Fritz-Peter Hessberger[2] — [1]Institut für Angewandte Physik, TU Darmstadt, 64289 Darmstadt — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, 64291 Darmstadt — [3]Helmholtzinstitut Mainz, 55128 Mainz — [4]Institut für Kernphysik, JGU Mainz, 55128 Mainz

The study of the atomic structure of transfermium elements like nobelium (No) and lawrencium (Lr) via Radiation Detected Resonance Ionization Spectroscopy (RADRIS) is one of the most fascinating disciplines of modern atomic physics. It allows the determination of relativistic effects at the heaviest elements and provides a critical test of theoretical predictions. For these transfermium elements no experimental data on atomic level schemes are available at present.

First experiments on ^{254}No were performed in 2007, in which a buffer gas cell with an overall efficiency of 1% [H. Backe et al., Eur. Phys. J. D 45 (2007) 99] was employed. In this experiment the evaporation temperature of nobelium was determined for the first time. To increase the efficiency of the buffer gas cell, off-line measurements have been performed with nat. ytterbium, the chemical homologue of nobelium. Also on-line experiments during a parasitic beamtime in 2012 provided an insight into the critical parameters of our setup. The results of the off-line and on-line measurements are briefly summarized in this talk.

A 10.5 Mon 17:30 F 428

Ion-lithium dynamics studied with an in-ring MOTReMi — Elisabeth Bruehl[1], Natalia Ferreira[1], •Johannes Goullon[1], Renate Hubele[1], Aaron LaForge[2], Hannes Lindenblatt[1], and Daniel Fischer[1] — [1]Max-Planck-Institut für Kernphysik, Heidelberg — [2]Physikalisches Institut, Universität Freiburg

The understanding of few-particle dynamics is a fundamental and challenging task in physics. With the investigation of ion-atom collisions simple few-body Coulomb-systems can be studied and theoretical models can be tested, especially since kinematically complete experiments with Reaction Microscopes (ReMi) are feasible. In our experiment such a ReMi is combined with a magneto-optical trap (MOT) preparing a cold lithium target and all implemented in an ion storage ring which provides brilliant and intense projectile beams. Due to the optical transitions driven in the MOT also excited and even polarized targets become available. In this contribution fully differential cross sections of different scattering processes like single ionization, single capture and transfer ionization will be presented.

A 10.6 Mon 17:45 F 428

Broadband lasercooling of relativistic ions at the ESR — •Danyal Winters[1], Michael Bussmann[2], Weiqiang Wen[1,3], Johannes Ullmann[1], Rodolfo Sanchez[1,4], Matthias Lochmann[1,4], Colin Clark[1], Tobias Beck[5], Benjamin Rein[5], Sascha Tichelmann[5], Mathias Siebold[2], Michael Seltmann[2], Dacheng Zhang[3], Jie Yang[3], Christina Dimopoulou[1], Fritz Nolden[1], Markus Steck[1], Wilfried Nörtershäuser[1,4,5], Ulrich Schramm[2], Thomas Kühl[1,4,7], Gerhard Birkl[5], Thomas Walther[5], Xinwen Ma[3], and Thomas Stöhlker[1,6,7] — [1]GSI Darmstadt — [2]HZDR Dresden — [3]IMP CAS Lanzhou, China — [4]Uni Mainz — [5]TU Darmstadt — [6]Uni Jena — [7]HI Jena

We present new results on broadband laser cooling of stored relativistic C^{3+} ion beams at the ESR in Darmstadt. For the first time we could show laser cooling of bunched relativistic ion beams using a UV-laser which could scan over a very large range and thus cool all the ions in the 'bucket'. This scheme is much more versatile than a previous scheme, where the bunching frequency was scanned relative to a fixed laser frequency. We have also demonstrated that this cooling scheme works without pre-electron cooling, which is a prerequisite for its general application to future storage rings and synchrotrons, such as the HESR and the SIS100 at FAIR. We also present results from in vacuo VUV-fluorescence detectors, which have proven to be very effective.